CBCS SCHEME

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18ME42

Fourth Semester B.E. Degree Examination, June/July 2023
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of thermodynamic data hand book is permitted.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

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Module-1

1 a. Define the following terms :
(i) Compression ratio.
(ii) Cut off ratio.
(iii) Thermal efficiency.
(iv) Relative efficiency. **(04 Marks)**

b. Derive an expression for air standard efficiency of a diesel cycle. **(08 Marks)**

c. Calculate the loss in the ideal efficiency of a diesel engine with compression ratio 14 if the cut off ratio is delayed from 5% to 8%. **(08 Marks)**

OR

2 a. What do you mean by detonation? Name the factors affecting detonation. **(04 Marks)**

b. With a P-θ diagram describe the stages of combustion in CI engine. **(08 Marks)**

c. During a 60 minutes trial on a single cylinder oil engine having cylinder dia 300 mm, stroke 450 mm and working on two stroke cycle. The following observations were made :
Total fuel used = 9.6 ltr, Heating value of fuel = 45000 kJ/kg,
Total number of revolution = 12624, Gross mep = 7.24 bar,
Pumping mep = 0.34 bar, Net brake load = 3150 N
Brake drum dia = 1.78 m, Rope dia = 40 mm
Cooling water circulated = 545 ltr
Cooling water temperature rise = 25°C
Specific gravity of oil = 0.8
Determine : IP, BP, mechanical efficiency and Draw the Heat balance sheet. **(08 Marks)**

Module-2

3 a. Explain Brayton cycle with line diagram, P-V diagram and derive an expression for pressure ratio for maximum work. **(10 Marks)**

b. A gas turbine unit has a pressure ratio of 6 : 1 and maximum cycle temperature of 610°C. The Isentropic efficiencies of compressor and Turbine are 0.8 and 0.82 respectively. Calculate the power output in kW of an electric generator geared to the turbine when the air enters the compressor at 15°C at the rate of 16 kg/sec.
Take C_P = 1.005 kJ/kg, γ = 1.4 for air.
C_P = 1.11 kJ/kg, γ = 1.333 for gas. **(10 Marks)**

OR

4 a. Explain the methods for the improvement of thermal efficiency of a open cycle gas turbine. **(10 Marks)**

b. Explain the following jet propulsion system :
(i) Ramjet Engine (ii) Rocket Engine. **(10 Marks)**

Module-3

5 a. Why Carnot cycle is practically not possible? **(04 Marks)**

b. State the advantages of regenerative cycle over Rankine cycle. **(04 Marks)**

c. Explain with sketch, the parameters affecting the Rankine cycle. **(12 Marks)**

OR

6 a. Explain with sketch, T-S and S-H diagram, the regenerative Rankine cycle. **(10 Marks)**

b. A simple Rankine Cycle works between pressure 30 bar and 0.04 bar, the initial condition of steam being dry saturated. Calculate the cycle efficiency, work ratio and specific steam consumption. **(10 Marks)**

Module-4

7 a. For a reversed Brayton cycle show that $COP = \frac{1}{r_P^{\gamma-1}} - 1$. **(10 Marks)**

b. With neat diagram, explain steam jet refrigeration. **(10 Marks)**

OR

8 a. Define the following terms :

(i) Dry bulb temperature

(ii) Dew point temperature

(iii) Specific humidity

(iv) Relative humidity

(v) Degree of saturation **(10 Marks)**

b. The atmospheric conditions are 20°C and specific humidity of 0.0095 kJ/kg of dry air. Calculate :

(i) Partial pressure of water vapour

(ii) Relative humidity **(10 Marks)**

Module-5

9 a. Derive an expression for isothermal efficiency of a single stage air compressor. **(10 Marks)**

b. An air compressor takes in air at 1 bar and 30°C compresses it according to the law $PV^{1.2} = C$. Air is delivered to a receiver at a constant pressure of 10 bar, determine temperature at the end of compression, WD and Heat transferred during compression/kg air. Neglect clearance. Take R = 0.287 kJ/kgK. **(10 Marks)**

OR

10 a. Define steam Nozzle and Name the types of nozzle. **(04 Marks)**

b. With a neat sketch, describe the working of a steam injector. **(06 Marks)**

c. Steam approaches a nozzle with a velocity of 250 m/s, 3.5 bar and dryness fraction 0.95. If the back pressure is 2 bar, assuming flow to be isentropic, find the final condition of steam and drop in Enthalpy. Also find the exit velocity and the area at exit of steam nozzle if the flow rate is 2700 kg/h. **(10 Marks)**

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